4.4 Food and Farm Product Surveillance

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Foodstuffs, including milk, vegetables, fruits, and wine, were collected in 1996 at several locations surrounding the Hanford Site (Figure 4.4.1). Samples were collected primarily from locations in the prevailing downwind directions (south and east of the site) where deposition of airborne effluents from Hanford could be expected. Samples were also collected in generally upwind directions at the site perimeter and at locations somewhat distant from the site to provide information on background radioactivity.

The food and farm product sampling design addresses the potential influence of Hanford Site releases in two ways: 1) by comparing results from several downwind locations to those from generally upwind or distant locations and 2) by comparing results from locations irrigated with Columbia River water withdrawn downstream from Hanford to results from locations irrigated with water from other sources. In 1996, the food and farm product sampling schedule was modified by establishing a 2- or 3-year rotation for certain farm products. Additionally, analyses for specific radionuclides that historically have not been detected in a food or farm product were discontinued. These changes were adopted because of the site's mission emphasis on cleanup. Specific details of the revised food and farm product sampling design, including sampling locations and radionuclides analyzed, are reported in DOE (1994a) and Bisping (1996) and are summarized in Table 4.4.1.

Gamma scans (cesium-137, cobalt-60, and other radionuclides; see Appendix E) and strontium-90 analyses were performed routinely for nearly all products. Additionally, milk was analyzed for iodine-129, and wine was analyzed for tritium. Radionuclide concentrations in most samples were less than the limits of detection. Results for fruits and vegetables are reported in picocuries per gram wet weight. Results for tritium in wine are reported in picocuries per liter of liquid distilled from wine. Most tritium is found as water, and very little tritium is organically bound to other constituents present in food products.

Tritium and iodine-129 are released to the atmosphere from site facilities and to the Columbia River via shoreline springs. Strontium-90 is released to the Columbia River through shoreline springs. Cesium-137 is present in atmospheric fallout from weapons testing and is found in site radiological waste.

For many radionuclides, concentrations are below levels that can be detected by the analytical laboratory. When this occurs for an entire group of samples, a nominal detection limit is determined by using two times the total propagated analytical uncertainty (2-sigma). The value from a group of samples is used as an estimate of the lower level of detection for that analyte and particular food product. The total propagated analytical uncertainty includes all sources of analytical error associated with the analysis (e.g., counting errors and errors associated with weight and volumetric measurements). Theoretically, reanalysis of the sample should yield a result falling within the range of the uncertainty 95% of the time. Counting and propagated errors not given in this report may be found in Bisping (1997).

Collection of Milk Samples and Analytes of Interest

Composite samples of raw, whole milk were collected from three East Wahluke Area and three Sagemoor Area dairy farms near the site perimeter in the prevailingly downwind direction (see Figure 4.4.1). Milk samples were also collected from a Sunnyside Area dairy to indicate background radionuclide concentrations at a generally upwind location.

Milk was analyzed for strontium-90, iodine-129, and gamma emitters such as cesium-137 because these radionuclides have the potential to move through the air-pasture-cow milk or water-pasture-cow milk food chains. Gamma and strontium-90 analyses were conducted quarterly, and iodine-129 analyses were conducted on two semiannual composite samples.

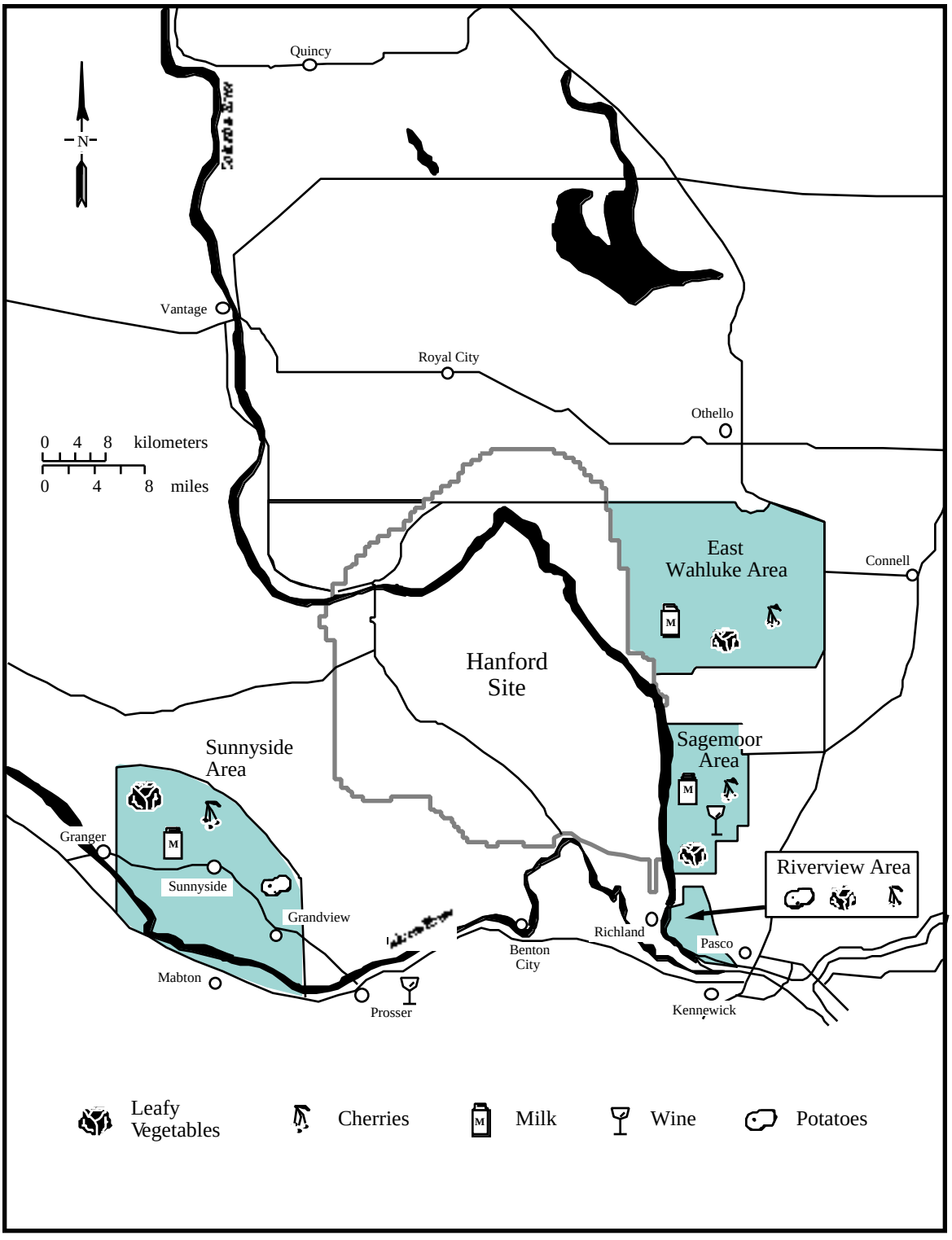

Figure 4.4.1. Food and Farm Product Sampling Locations, 1996

Table 4.4.1. Numbers of Locations, Sampling Frequencies, and Analyses Performed for Routinely Sampled Food and Farm Products, 1996[a]

Product	Number of Locations		Sampling Frequency[b]	Number of Locations Analyzed			
	Upwind	Downwind		^{3}H	Gamma	^{90}Sr	^{129}I
Milk	1	2	Q or SA	0	3	3	3
Vegetables	1	3	A	0	4	4	0
Fruit	1	3	A	0	4	4	0
Wine	2	2	A	4	4	0	0

(a) Products may include multiple varieties for each category. Not all analytes were assayed at all locations or for each variety of product.
(b) Q = quarterly, SA = semiannually, A = annually.

One factor influencing concentrations of radionuclides in milk is the source of food for the dairy cows. Dairy cows may be fed food grown outside of their sampling locations. Generally, levels of fallout radioactivity in environmental media correlate positively with the amount of precipitation that an area receives. The agricultural areas around the site are arid and historically have received less weapons-testing atmospheric fallout than some distant locations. Consequently, background levels of radioactivity in hay or alfalfa grown in some distant locations and purchased by local dairies may contribute more radioactivity to milk than background levels in feed grown locally. Alternatively, it is possible that alfalfa fed to dairy cows in Sunnyside could have been grown in Sagemoor. Fallout radionuclides in feed may be a significant source of radioactivity in animal products; however, observed levels in milk are usually near levels considered to be background.

Radiological Results for Milk Samples

Strontium-90 was measured in 4 of 12 (33%) milk samples analyzed in 1996, with no apparent differences between upwind and downwind locations. Concentrations of strontium-90 remain near the nominal detection limit (0.7 pCi/L) and are relatively constant over the past 6 years (Figure 4.4.2). The maximum observed concentration of strontium-90 in milk in 1996 was 1.3 ± 0.62 pCi/L. While there is no strontium-90 standard for milk, the drinking water standard (based on a 2-L/d consumption) is 8 pCi/L (40 CFR 141). The maximum milk consumption rate for estimating dose is approximately 0.75 L/d (see Appendix D, Table D.2).

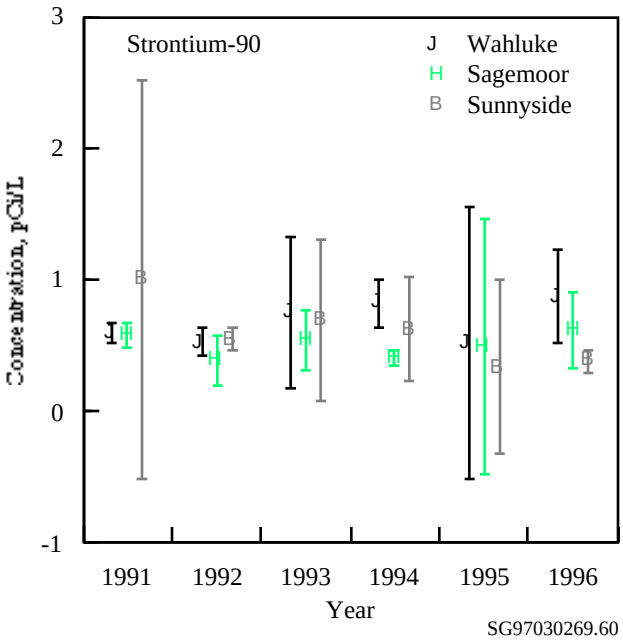

Figure 4.4.2. Mean (±2 standard error of the mean) Strontium-90 Concentrations in Milk, 1991 Through 1996. As a result of figure scale, some uncertainties are concealed by point symbol.

Iodine-129 was identified by high-resolution mass spectrometry in six milk samples tested. In recent years, the levels of iodine-129 in milk collected from generally downwind dairies in the Sagemoor and East Wahluke Areas have persisted at levels two to four times greater than levels measured upwind in the Sunnyside Area (Figure 4.4.3). Iodine-129 concentrations have been declining with the end of nuclear production activities onsite, and there appears to be no concentration differences between upwind and downwind locations in 1995 and 1996. Iodine-129 contributes less than 1% of the dose to the maximally exposed individual through the consumption of dairy products (Section 5.0, "Potential Radiation Doses from 1996 Hanford Operations"). The maximum observed concentration of iodine-129 in milk in 1996 was 0.0005 ± 0.0001 pCi/L in a sample collected from the Sagemoor Area. While there is no iodine-129 standard for milk, the federal drinking water standard is 1 pCi/L (EPA 1976).

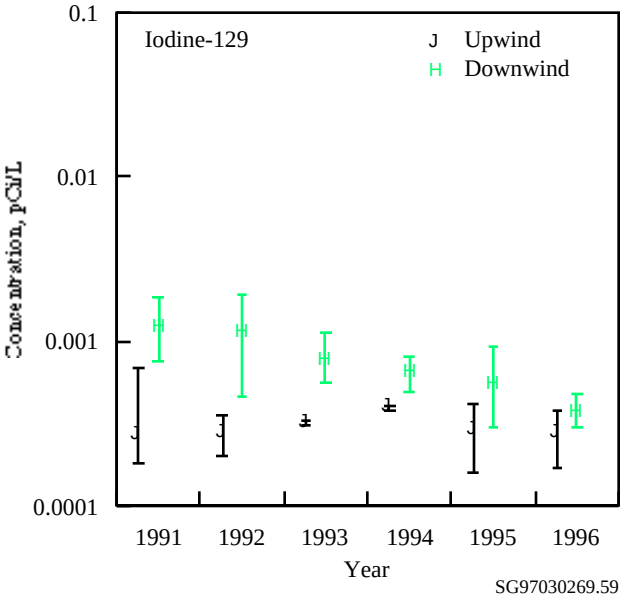

Figure 4.4.3. Mean, Maximum, and Minimum Iodine-129 Concentrations in Milk, 1991 Through 1996. As a result of figure scale, some uncertainties are concealed by the point symbol.

None of the 12 milk samples collected and analyzed in 1996 contained detectable concentrations of cesium-137 (<2.6 pCi/L). While there is no cesium-137 standard for milk, the drinking water standard is 200 pCi/L (EPA 1976). Additionally, no other manmade gamma emitters were detectable in milk (Bisping 1997).

Collection of Vegetable Samples and Analytes of Interest

Samples of leafy vegetables (i.e., cabbage, broccoli, beet tops, or turnip greens) and potatoes were obtained during the summer from gardens and farms located within selected sampling areas (see Figure 4.4.1). Samples were collected from the Riverview Area to assess potential contamination to crops from irrigation water from the Columbia River. Irrigation water for the Riverview Area is withdrawn from the Columbia River downstream from Hanford.

Leafy vegetables are sampled because of the potential deposition of airborne contaminants and, at some locations, exposure to potentially contaminated irrigation water withdrawn from the Columbia River downstream of the Hanford Site. All vegetable samples were analyzed for gamma-emitting radionuclides and strontium-90.

Radiological Results for Vegetable Samples

Many of the analytical results for vegetables were below nominal detection limits for specific radionuclides. Strontium-90 was detected in leafy vegetable samples collected from the Riverview and East Wahluke Areas in 1996 (Bisping 1997) but was below detection (0.005 pCi/g) in samples from the Sunnyside and Sagemoor Areas. Measurements of gamma emitters in vegetable samples were all less than their respective detection limits and are consistent with results in recent years.

Collection of Fruit Samples and Analytes of Interest

Cherries were collected during harvest from the areas shown in Figure 4.4.1. The edible portions were analyzed for gamma emitters and strontium-90.

Radiological Results for Fruit Samples

Measurable levels of manmade radioactivity were not detected in cherries in 1996. These results are consistent with measurements in grapes, apples, and melons over recent years (Bisping and Woodruff 1991, 1992, 1993,

Bisping 1994, 1995). Nominal levels of detection were 0.02 pCi/g wet weight for cesium-137 and 0.004 pCi/g wet weight for strontium-90.

Collection of Wine Samples and Analytes of Interest

Locally produced red and white wines (1996 vintage grapes) were analyzed for tritium and gamma-emitting radionuclides. The wines were made from grapes grown at individual vineyards downwind of the site and at an upwind location in the lower Yakima Valley. Two samples each of red and white wines were obtained and analyzed from each upwind and downwind location.

Radiological Results for Wine Samples

Gamma spectroscopy of wine samples did not indicate the presence of cesium-137 in any of the samples. The nominal detection limit for cesium-137 in wine is approximately 3 pCi/L.

Prior to 1996, tritium concentrations in wine samples were determined by distilling the wine and analyzing the distillate with a liquid scintillation counter. The distillation procedure resulted in some samples containing alcohol, and alcohol can affect the accuracy of the scintillation counter results. In 1996, an electrolytic enrichment method was employed to improve the accuracy of the analysis. The electrolytic method also lowered the tritium detection limit from 300 to 10 pCi/L. Consequently, with the exception of 1993, tritium concentrations reported for 1996 wine samples are significantly lower than tritium concentrations reported in wine samples collected in previous years (Dirkes and Hanf 1995, 1996). In 1993, several wine samples were shipped to Lawrence Livermore National Laboratory for analysis by a special mass spectrometry technique that measured the amount of helium in the wine. Tritium decays to helium, and the amount of helium (at equilibrium) can be used to accurately assay the amount of tritium in the sample. The detection limit for this technique was similar to the detection limit for the electrolytic distillation method. Results for these samples were also lower than results previously obtained using the old distillation method but were similar to those obtained in 1996 using the electrolytic distillation method (Figure 4.4.4). Therefore, comparisons between 1996 data and data from all other years except 1993 are not practicable.

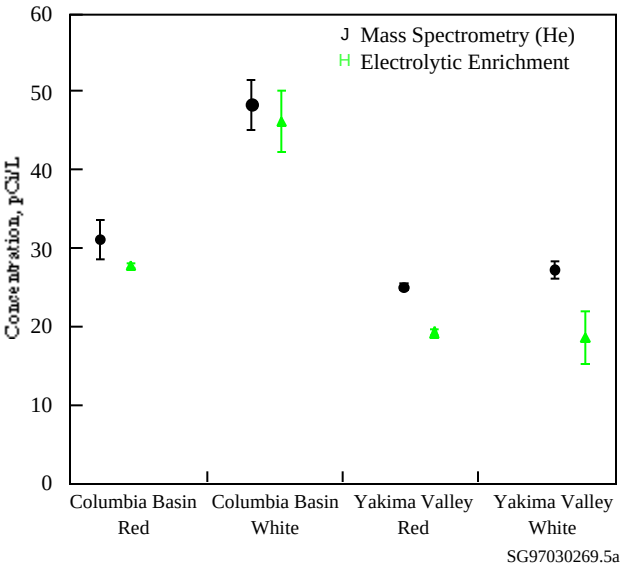

Figure 4.4.4. Comparison of Tritium Concentrations in Wine Samples Collected in 1993 and 1996. As a result of figure scale, some uncertainties are concealed by the point symbol.

Concentrations in 1996 wine samples ranged from 15.1 to 50.2 pCi/L of distillate. Differences in locations may reflect differences in irrigation water. Deep groundwater may not contain tritium while surface-water concentrations may range from 30 to 80 pCi/L (see Section 4.2). While there is no tritium standard for wine, the drinking water standard (40 CFR 141) is 20,000 pCi/L. This standard is based on the daily consumption of 2 L of water and the daily consumption of wine is much less than 2 L.